NOTE I.

SYSTEMATIC MONOGRAPH OF THE ATLANTIDAE (HETEROPODA) WITH ENUMERATION OF THE SPECIES IN THE LEYDEN MUSEUM

BY

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(With plates 1—5).

Having recently [1]) tried to bring some order into the great confusion, existing in the systematic literature on the Heteropods, and to eliminate some of the difficulties, which the investigator of this group of animals is sure to encounter with, I have been convinced, more than anybody else, that my study could have nothing but a provisional value, and that a firmer base could only be obtained by means of continued labour, and comparison of more material.

For a systematic revision I have chosen the family Atlantidae. These animals with their tiny, inconspicuous shells, have received but little attention, and after Souleyet's memorable work, more than half a century ago, only very few naturalists have dealt with the group. Among them I may name Gould, Smith, Oberwimmer, Vayssière and myself. Yet it may safely be said, that the discrimination of the species is perhaps more difficult than in any other family of the Heteropods.

Mr. P. J. Buitendijk presented, shortly ago, to the Museum, a collection of plankton, brought together, almost

1) J. J. Tesch. Die Heteropoden der Siboga-Expedition, Siboga-Expeditie, Monogr. LI. 1906.

exclusively, in the Indian Ocean and the Red Sea. The study of this material has been a most laborious task, as I had to search for the small Atlantidae among innumerable quantities of Copepods, Ostracods, Cumacea, etc., with which each of the glass vessels was crowded. The collection, originating from the surface of the Ocean, is rich in young forms and in not full-grown specimens, which seems to point to the fact, quite as in the Pteropoda, that the adult specimens of the Atlantidae, and probably of all the Heteropoda, are comparatively rarely found at the surface, and generally prefer deeper zones.

I should not have been able to bring my study to a rather satisfactory end, if Prof. L. Joubin had not most kindly sent to me, on my request, the valuable types of Souleyet, which are deposited in the »Muséum d'Histoire naturelle" at Paris. I beg this gentleman to take my sincere thanks for the great service he has rendered me. Taking into account its long preservation, for seventy years, in alcohol, the collection proved to be in an excellent state. Unfortunately, two of Souleyet's species, *Atlanta quoyana* and *Atlanta involuta*, were not represented, while a third (*Atlanta depressa*) had its shell quite dissolved. So, there remains some uncertainty, in my opinion at least, about the two firstnamed forms (which are neither in the British Museum); on the other hand, I have been fortunate enough to recognize *Atlanta depressa* in the collection of Mr. Buitendijk.

I have thought it useful to figure all the species of Souleyet again [1]), with exception of those, of which good drawings, leaving no doubt as to the identification of the species, already exist. Souleyet's figures, though generally remarkably accurate, are, however, too small, and he has overlooked several remarkable features about sculpture, which may supply excellent specific characters.

1) When nothing else is noticed, the figures here given are drawn after Souleyet's types, with the camera.

May this paper contribute something to our knowledge of the group, and facilitate in any way the task of future investigators — a task which I know by experience to be by no means an easy one.

The genera of the Atlantidae.

Two genera are generally admitted, *Oxygyrus* and *Atlanta*, which are distinguished by a whole series of characters. After the study of Souleyet's types I have thought it necessary to add a third genus, *Protatlanta*, the type of which is represented by Souleyet's *Atlanta lamanoni*, which name has been altered by Smith, for reasons of priority in nomenclature, in *Atlanta souleyeti*. This remarkable new genus forms in many respects a transition between *Atlanta* and *Oxygyrus*, but it cannot be classed among either of these genera.

Key to the genera.

1. Shell nautiloid, all whorls in the same plain, horny to a greater or lesser extent, according to age; keel membranous, nearly as broad as the last whorl; operculum triangular; animal with a very bulky proboscis and a large sucker on the fin . . . . . *Oxygyrus* Benson.

Shell right-handed; apical whorls forming a little spire at one side of the flat shell, an umbilicus existing at the opposite side; operculum rounded, oval, with a spiral portion . . 2

2. Keel of the shell cartilaginous, encircling nearly the whole last whorl (but often wanting as it is most easily to be removed) and extending to the outer lip of the aperture; shell quite [1]) cartilaginous (?); animal very much resembling that of *Oxygyrus*, with a mighty proboscis and a large sucker . . . . . *Protatlanta* mihi.

1) The specimens of Souleyet, which are very well preserved, show no trace of chalky matter in their shells. On the other hand, Smith (p. 44) has stated, that the shell is „of the same vitreous character" as in *Atlanta*. This question may therefore remain unsettled.

Keel of the shell chalky, as is indeed the whole shell, outer lip of the aperture always more or less fissured; animal with a slender proboscis and a smaller sucker on the fin . . . . . *Atlanta* Lesueur.

Oxygyrus Benson [1]).

Atlanta (*p. p.*) auctorum.
1835. *Oxygyrus* Benson.
1836. *Helicophlegma* (*p. p.*) d'Orbigny.
1841. *Ladas* Cantraine.

The well-known typical representant of this genus, *O. keraudreni* (Lesueur), has been classed firstly among the species of *Atlanta* (so by Lesueur himself, Rang, Cuvier, Deshayes), till Benson established a new genus for it. The diagnosis, given by this author of the type, his *O. inflatus*, which, moreover, has never been figured, is very incomplete and does not show any specific characters, although beyond doubt to be applied to *Oxygyrus*, and probably to the common *O. keraudreni*. It seems advisable to reject Benson's species.

I have shown in my monograph (pp. 49 and 50), that *Oxygyrus* n. sp. Macdonald is the young stage of a species of Souleyet. Leaving aside some doubtful forms (which I shall have occasion to refer to further on), there remain only two species.

Key to the species.

Shell cartilaginous for the greater part (in adult state), large (5—10 mm.), chalky part of shell without spiral lines; median plate of radula with three spines, of which the middle is the largest one, while the lateral spines are nearly obliterated . . *Oxygyrus keraudreni* (Lesueur).

Shell with its cartilaginous part (if present) smaller, small

1) As to the literature I may be allowed to refer to my former monograph and especially to E. A. Smith, Challenger-Expedition LXXII, 1888.

(0,5—3 mm.), chalky part, either wholly or on the penultimate whorl, provided with conspicuous undulating spiral lines; median plate of radula with three spines, all of nearly the same length . . . *Oxygyrus rangi* (Souleyet).

Species 1. *Oxygyrus keraudreni* (Lesueur).

1817. *Atlanta keraudreni* Lesueur.
1835. *Oxygyrus inflatus?* Benson.
1836. *Atlanta* (*Helicophlegma*) *keraudreni* d'Orbigny.
1840. „ *bivonae* Pirajno.
1841. *Ladas keraudreni* Cantraine.
1850. *Oxygyrus keraudreni* Gray.
1852. *Atlanta violacea?* Gould.
1852. „ *tessellata?* Gould.
1852. „ *mediterranea?* Costa,
non Quoy et Gaimard (1832), Souleyet (1852) [1]), Ray Lankester (1883) and Pelseneer (1906).

Animals:

Mediterranean,	date?	± 20 sp., Cantraine.
Atlantic Ocean,	(0° N., 23° W.), 1879,	1 sp., Kruisinga.
"	(1° S., 23° W.), 1879,	4 sp., "

Species 2. *Oxygyrus rangi* (Souleyet).

1852. *Atlanta rangi* Souleyet.
1862. *Oxygyrus* n. sp. Macdonald.
1888. *Oxygyrus rangi* Smith.

Animals:

Mediterranean,	date?	3 sp.,	Buitendijk.
Indian Ocean [2]),	January '06,	1 sp.,	"
"	April '06,	5 sp.,	"

1) Souleyet (Voy. Bonite) and after him Ray Lankester (Enc. brit.) and Pelseneer (Treatise of Zoology, p 161) erroneously refer a figure of *A. peroni* to *O. keraudreni*.

2) It may be stated here, that with the term „Indian Ocean" in this paper always the same route: Perim—Point de Galle—Sabang is meant.

I confess, that I entertain some doubt as to the specific distinctness of these two species. The features by which they are to be recognized, seem to be most conspicuous, but they all (except those of the radula) vanish with increasing age.

As I have pointed out formerly in my monograph (p. 50), and is f. i. stated by Oberwimmer, *O. keraudreni* passes in its youth through a *Bellerophina*-stage, as it is called, and it seems as if *O. rangi* is only an intermediate form between this *Bellerophina* and the full-grown *O. keraudreni*.

The specimens of Mr. Buitendijk were all young specimens in different stages of development and from them I inferred the following notes:

I. Shell of $^1/_2$ mm.: Quite chalky, wholly provided with undulating spiral lines. Form much rounded, which becomes yet more conspicuous by the total absence of a keel. Faintly tinted in rose. (*Bellerophina*).

II. Shell of 1 mm.: At the aperture a small amount of cartilaginous matter is deposited; this part of the shell is uncoloured and without sculpture. A very high cartilaginous keel at the aperture, but only over a short distance on the last whorl, and abruptly terminating. (Stage figured by Macdonald, and copied by me, Pl. I, fig. 5).

III. Shell of 2 mm.: The membranous part of the shell occupies the second half of the last whorl, and so does the keel which indeed is intimately connected with it.

IV. Shell of 2,5—3 mm. (of Souleyet): The membranous part of the shell has not extended further, but the first half of the last whorl, though chalky, does not show the spiral lines [1]), which have retired entirely to the penultimate whorl.

All these stages are to be referred to *O. rangi*. In my material of *O. keraudreni* the smallest specimen measures 5 mm. Here the whole last whorl is cartilaginous; the keel, which is very high on the second half of this whorl,

1) Only some transverse lines of growth are to be seen here.

becomes very low and inconspicuous on the first half, though reaching the inner lip, and so embracing the whole circumference of the shell. The separation of the cartilaginous and the chalky part of the shell is not quite clear, but it seems as if the membranous matter gradually covers the chalk and absorbs it. Sculpture is altogether absent.

Though there is a gap in my material betwéen the shells of 3 mm. and of 5 mm., the idea that *O. rangi* represents a young stage of *O. keraudreni* is very suggesting, also, because *O. rangi* has been caught by Mr. Buitendijk in the Mediterranean, which has always been regarded as the typical habitat of *O. keraudreni.*

But a few facts must be born in mind. Firstly, the *Bellerophina*-stage of *O. keraudreni*, as it is figured by Oberwimmer, exhibits spiral lines, but these do not undulate, as is decidedly the case in *O. rangi.* Such simple lines I have not observed in any specimen. And secondly, the radulae are indeed very different. I have pointed to it formerly (monograph, Pl. VII, figs. 3 and 5), and can only confirm, after repeated investigations, that in *O. keraudreni* the median plate carries three spines, the middle one of which is large, while the lateral ones are inconspicuous, whereas in *O. rangi* these spines are of nearly the same length.

To the genus *Oxygyrus*, and probably to *O. keraudreni*, another species, »*Atlanta violacea*" Gould, from the tropical Atlantic (copied by me, Pl. I, figs. 42 and 43) is likely to be referred; at least the shell is said to be nautiloid, with the last whorl »not rapidly enlarging, and unusually distended"; the keel is very high at the aperture (which, however, is elliptical, not rounded); and finally, the side-view, showing an umbilicus at both sides of the shell, the violaceous colour, especially on the spire, and the diameter (9,5 mm.) strongly suggest the idea that the species must be classed in *Oxygyrus.*

The same is true perhaps for another species of the same author, »*Atlanta tessellata*", also from the tropical

Atlantic, at least on account of the nautiloid shell, and the keel extending to the outer lip of the aperture. Unfortunately only a surface view of the shell is given (copied by me, Pl. I, fig. 44). I think the remarkable row of »square, violaceous spots, following around the middle of the spire" may be due to some accidental disposition of the organs of the animal itself, and not inherent to the shell. The diameter (nearly 6,5 mm.) also affords some argument to the affinity to *Oxygyrus*, as this diameter among the species of *Atlanta* is only attained by *A. peroni*, from which »*A. tessellata*" must be certainly separated. Some more certainty, however, cannot be obtained until renewed investigation of the type-specimen.

Finally »*Atlanta mediterranea*" Costa, from the Mediterranean, (copied by me, Pl. I, fig. 41), which is most imperfectly known, and which I had formerly (p. 10), though hesitatingly, referred to *Atlanta lesueuri*, belongs perhaps also in the genus *Oxygyrus*.

Protatlanta mihi.

1852. *Atlanta* (*p. p.*) Souleyet.

1862. *Oxygyrus* (*p. p.*) Macdonald.

Shell cartilaginous (see note p. 3), spire short, conical' projecting on one side, whorls much rounded in transverse section; keel horny, very high, commencing most conspicuously at the outer lip of the aperture, as in *Oxygyrus*, and here, as in this last-named genus, consisting of two plates, which leave a small space between them, in which the mantle of the animal projects.

Animal almost entirely as in *Oxygyrus*, with a very bulky proboscis and short tentacles; sucker at the fin very large.

Operculum as in *Atlanta*, with a small spiral portion.

The type of this new genus is »*Atlanta lamanoni*" of Souleyet, which name has been altered by E. A. Smith in »*Atlanta souleyeti*", as the term, used by Souleyet, had

been already applied, long before, by Costa to another species. The study of Souleyet's specimens has shown me, that they exhibit a series of remarkable features which justify the establishing of a new genus, as a transition between *Oxygyrus* and *Atlanta*.

Species 1. *Protatlanta souleyeti* (Smith).

1852. *Atlanta lamanoni* Souleyet, *non* Eschscholtz.
1888. *Atlanta souleyeti* Smith.

(Plates 1 and 2, figs. 1—6).

Shell with nearly four whorls, spire rather large, last whorl much enlarging, though not in the proportion as in *Atlanta*; spire projecting, distinctly visible in side view; at the umbilicus the last half of the penultimate whorl is to be seen, provided with ± 10 thin spiral lines, gradually disappearing on the last whorl (fig. 3).

The cartilaginous keel is very often wanting, as it is easily to be detached from the last whorl, which it embraces almost entirely, but terminates abruptly on the first part.

The animal resembles *Oxygyrus* in many respects (fig. 4). Proboscis very large and often swollen at the anterior part, buccal mass voluminous; tentacles short, situated at the lateral side of the eyes, which have a very broad base, and agree with those of *Oxygyrus*.

Sucker well developed, distinctly separated from the fin by means of a very short stalk; yet the proportion between sucker and fin is more like that of *Atlanta*, and so in favour of the last-named organ.

Radula (fig. 6) strong, as in all Atlantidae. Median plate with three spines, lateral ones directed outwards, and smaller than the median spine. Intermediate tooth with a large median crest, which extends nearly to the tip, resembling somewhat that of *Pterotrachea*. Lateral teeth both of the same length, slightly curved.

Operculum (fig. 5) like that of *Atlanta*, very thin, transparent, cartilaginous. Spiral portion (to which the

musculous part of the tail is inserted) with a short spiral line and a few concentric ones; distal half provided with some parallel striae.

As may be inferred from the foregoing description, *Protatlanta* with the only species *P. souleyeti* (Smith), forms in many respects a remarkable transition between *Oxygyrus* and *Atlanta*. To repeat it shortly: the cartilaginous consistence of the shell and the keel, the form of the last, the proboscis and the tentacles, are like that of *Oxygyrus*; the projecting spire, the proportion between sucker and fin, and the spiral operculum, are all features, which resemble *Atlanta*.

Diameter of the shell 2 mm. or less.

The species seems to live only in the Atlantic, from which it is recorded both by Souleyet and Smith (Challenger-Expedition).

As I had only five type-specimens of Souleyet at my disposal, I have not ventured to search for the mucous glands of the mouth, which occur in *Atlanta* (recorded by me recently, p. 51, Pl. VII, fig. 8).

Atlanta Lesueur.

1817. *Atlanta* Lesueur.
1825. *Steira* Eschscholtz.
1868. *Atalanta* Knocker.

Shell and keel chalky, not flexible as in the foregoing genera, outer lip of the aperture fissured. Animal with a slender proboscis and long tentacles. Operculum with a spiral portion.

For further particulars I may refer to the diagnosis I have given in my monograph (pp. 50 and 51); I shall only add, that the keel is made up of two plates (as in *Carinaria*), leaving, at least on the last whorl, a small space between them. This keel becomes gradually lower towards the aperture, and disappears entirely at the fissure in the outer lip.

It is especially in *Atlanta* that the disproportion of the whorls is most clearly pronounced. We may distinguish safely between the spire (all the whorls but the last one) and the last whorl, which is always rolled up, in its whole extent, in the same plain, whereas the spire is more or less elevated, but nearly always very small, and consisting of generally 4—5 whorls, which follow each other regularly and gradually increasing.

By far the most species of the Atlantidae belong to this genus. Formerly, in my monograph (p. 6), I published a list containing 27 names; one of them, however, being identical with »*Atlanta souleyeti*" Smith, while three other terms (see above) are likely to be referred to *Oxygyrus*, the number should be reduced to 23, which, with addition of two species added by me (pp. 53, 55, Pl. VII, figs. 9 and 10, Pl. VIII, figs. 14—18), makes a total number of 25 names [1]). I shall not repeat this list here, but shall only try to discriminate certain groups.

Firstly we may separate a few species, which are most insufficiently described, sometimes even never figured, and which, in my opinion, should be rejected entirely. They are:

A. lamanoni (Eschscholtz).
„ *helicialis* Sowerby.
„ *sp.* 1 Gray (most likely = *Oxygyrus keraudreni* Lesueur).
„ *sp.* 2 Gray (most likely = *A. peroni* Lesueur).
„ *planorboides* Forbes.

Secondly three names are synomyms of other forms, already known:

A. rosea Souleyet = *A. peroni* Lesueur.
„ *inclinata* Vayssière (his fig. 91) = *A. fusca* Souleyet.
„ *oligogyra* Tesch = *A. lesueuri* Souleyet.

Further I regard a few species as uncertain; in some cases the type-specimens have been lost, and I have not

1) Strictly spoken there are 26 names, as Vayssière under the title »*A. inclinata*" comprises two certainly distinct species.

succeeded in obtaining absolute certainty about them, though believing they may be recognized in the future. They are:

A. involuta Souleyet (= *A. turriculata?* Souleyet), type lost.
„ *quoyana* Souleyet (= *A. inflata?* Souleyet), type lost.
„ *quoyana* Vayssière (= *A. helicinoides?* Souleyet).
„ *inclinata* „ (his fig. 90) (= *A. inflata?* Souleyet).
„ *primitia* Gould } (= *A. lesueuri?* Souleyet).
„ *cunicula* „ }

So there remain only 12 names, which, in my opinion, refer certainly to distinct species:

A. peroni Lesueur.
„ *steindachneri* Oberwimmer.
„ *affinis* Tesch.
„ *gaudichaudi* Souleyet.
„ *lesueuri* „
„ *inflata* „
„ *helicinoides* „
„ *depressa* „
„ *fusca* „
„ *turriculata* d'Orbigny.
„ *inclinata* Souleyet.
„ *gibbosa* „

These species may be arranged in different groups, as I shall try to show. Not ascribing to these groups the value of subgenera, I shall call them simply after one species which may serve as the type of the group. It appeared impossible to me to comprise in short diagnoses the very slight differences among the species, and so I thought it sufficient, for the sake of provisional orientation, to give the following key.

Key to the groups.

1. Shell very flat, whorls all in nearly the same plain, spire scarcely or even not at all projecting beyond the last whorl, outer lip generally deeply fissured; keel (in adult specimens) often penetrating between the whorls, so that even the whole penultimate whorl may become encircled

by the keel; shell usually colourless, without spiral lines, sometimes attaining a size of nearly 10 mm.

Atlanta peroni-group.

Shell with a short conical spire, always projecting beyond the last whorl; keel generally not reaching the inner lip of the aperture; sculpture often present in the form of spiral lines on the apical whorls; shell small, with a maximum size of 3—4 mm., usually smaller 2

2. Spire straight (as regards the plain in which the last whorl is rolled up) or very faintly reflexed backwards, conical, with rather obtuse apex, generally coloured with brown or yellow tints, which vanish almost entirely on the last whorl . . . . . *Atlanta inflata*-group.

Spire reflexed, either backwards or forwards, in various ways of distinction. 3

3. Shell horny-coloured, spire always darker, slender; keel extending nearly to the outer lip, fissure therefore scarcely developed . . . . . *Atlanta turriculata*-group.

Shell colourless; spire very distinctly reflexed, outer lip deeply fissured . . . . . *Atlanta inclinata*-group.

Group of *Atlanta peroni*.

Five species are to be distinguished here:

1. *A. peroni* Lesueur.
2. „ *steindachneri* Oberwimmer.
3. „ *affinis* Tesch.
4. „ *gaudichaudi* Souleyet.
5. „ *lesueuri* „

They are all characterized by their flat shells, which are nearly planorboid. The first three are (in adult state at least) remarkable by the keel, which separates the last whorl from the penultimate one, penetrating more or less between the whorls. In *A. gaudichaudi* and *A. lesueuri* the spire is extremely small, in comparison with the last whorl. For reasons mentioned above, I shall not try to give a key to the species of this group, which are recognizable

only to an experienced eye. It will be more advisable to refer to the figures.

Species 1. *Atlanta peroni* Lesueur.

1817. *Atlanta peroni* Lesueur.
1832. „ *keraudreni* Quoy et Gaimard.
1840. „ *costae* Pirajno.
1852. „ *keraudreni* Souleyet.
1852. „ *rosea* Souleyet, *non* Tesch (1906).
1883. *Oxygyrus keraudreni* Ray Lankester (copied by Pelseneer in Treatise of Zoology, Mollusca, fig. 141, p. 161, 1906).

(Plates 1 and 2, figs. 7—9).

Dry shells:

Atlantic Ocean, purchased 1907, 15 sp., Sowerby and Fulton.

Animals:

Red Sea,	March 16, '07,	2 sp.,	Buitendijk.
Gulf of Aden,	August '06,	1 sp.,	„
Indian Ocean,	April '06,	1 sp.,	„

As is well known, the keel penetrates to a great extent between the whorls, but this character is only pronounced in adult specimens. The young shells, of which the material collected by Mr. Buitendijk consists, belong to the form *rosea*, which has been regarded by Souleyet as a distinct species. I have carefully examined shells of all ages, and after becoming convinced that the spires of *A. rosea* and *A. peroni* are absolutely identical (as is also the case with the characteristic radula), I may be allowed to give the following series:

I. Shells of 0,5—2 mm. (figs. 7—9). *Rosea*-form. Keel not reaching inner lip of aperture, faintly tinted in brown at the base; spire somewhat projecting (fig. 8); at the underside of the shell more than two whorls are visible (fig. 9).

II. Shells of 3—4 mm. Like the foregoing, but keel extending somewhat further and reaching the inner lip, sometimes even penetrating between this lip and penultimate whorl.

III. Shells of 5—10 mm. With advancing age the keel penetrates further between the whorls and the whole penultimate whorl may be (in the largest specimens) embraced by the keel (figured by Vayssière, Pl. VI, fig. 86), but inner lip always in close contact with it; at the under side of the shells three whorls may be seen. This stage is the typical *peroni*-form.

As has been said above, the spires of *A. rosea* and *A. peroni* are wholly identical. Another proof that *A. rosea* is nothing but the young stage of *A. peroni* is afforded by the radulae. Vayssière (p. 50, Pl. VI, figs. 88 and 89) described and figured the radula of *A. peroni* and I can affirm his assertions after repeated investigation. With this radula the same organ in *A. rosea* agrees entirely. The intermediate plate exhibits at its lateral side a very distinct tooth, together with the usual point of this plate, but much smaller; the lateral teeth are much shorter.

The shell is wholly colourless, with exception of a faint brown colour at the base of the keel, which occasionally occurs. Neither is any sculpture to be seen, only a few striae of growth. A good description is given by Vayssière (pp. 50 and 51).

The specimens of the Siboga-Expedition, which I have formerly referred to »*A. rosea*" (p. 57, Pl. VIII, figs. 22—24) really do not belong to this species, but to *A. depressa* Souleyet (see p. 21). With the information I am fortunate enough to have acquired after examination of Souleyet's types, I readily apologize for my error.

Species 2. *Atlanta steindachneri* Oberwimmer.

1898. *Atlanta steindachneri* Oberwimmer.

For description and figures I refer to Oberwimmer (copied by me in my monograph, p. 12, Pl. II, figs. 50 and 51).

This species is to be distinguished by the inner lip and the adjacent part of the last whorl not being in close contact with the keel, thus showing a tendency to detorsion, as this is pronounced much more clearly in *Carinaria*. One may suppose this to be a character dependent on age, but this idea is contrary to the fact that *A. steindachneri* reaches a size of only 3—4 mm., whereas even the largest specimens of *A. peroni* (10 mm.) never show a similar loosing of the whorls. In all other respects (the radula of *A. steindachneri* is not known) the two species are closely connected.

Species 3. *Atlanta affinis* Tesch.

1906. *Atlanta affinis* Tesch.

For description and figures I refer to my monograph (p. 53, Pl. VIII, figs. 9 and 10), where I have tried to give a sufficient diagnosis of this species, which, like the foregoing, is very closely connected with *A. peroni*. Besides some characteristic features of the shell, I may draw attention to the fact that the intermediate plate of the radula does not show a small tooth at its concave, lateral side, and that the lateral teeth are comparatively longer than in *A. peroni*.

Species 4. *Atlanta gaudichaudi* Souleyet.

1852. *Atlanta gaudichaudi* Souleyet.

(Plates 1 and 2, fig. 10).

Dry shells:

N. Atlantic Ocean, purchased 1907, 2 sp., Sowerby and Fulton.

Animals:

Red Sea,	May	'06,	1 sp.,	Buitendijk.
Indian Ocean,	April	'06,	2 sp.,	„
„	September	'06,	1 sp.,	„
„	November	'06,	1 sp.,	„

Poeloe Weh,	March 25,	'07,	2 sp.,	Buitendijk.
Malacca-street,	January	'06,	4 sp.,	„
Java-Sea,	May	'06,	2 sp.,	„
„	December	'06,	2 sp.,	„

For description and figures I refer to my monograph (p. 54, Pl. VII, figs. 11—13); I have only given here a drawing of the shell seen from above. The features, distinguishing this species from *A. peroni* and allied forms, are supplied by the keel, not (or scarcely) penetrating between the inner lip and the penultimate whorl, by the smaller spire (the shell nearly wholly consisting of the last whorl), the suture being always tinted with a reddish-brown colour, which becomes most clear at the base of the keel, and finally by the radula (very powerful in this species, as I counted more than 100 transverse rows), in which the intermediate plate is not provided with a small tooth at the lateral side. Shell colourless (with exception of the suture), without sculpture, only with a few indistinct lines of growth.

Species 5. *Atlanta lesueuri* Souleyet.

1852. *Atlanta lesueuri* Souleyet.
1852. *Atlanta primitia?* Gould.
1852. *Atlanta cunicula* Gould.
1906. *Atlanta oligogyra* Tesch.

(Plates 1 and 2, figs. 11 and 12).

Dry shells:

W. Pacific Ocean, purchased 1907, 16 sp., Sowerby and Fulton.

Animals:

Red Sea,	September	'04,	1 sp.,	Buitendijk.
„	April	'06,	1 sp.,	„
„	May	'06,	1 sp.,	„
„	November	'06,	1 sp.,	„
Gulf of Aden,	December	'05,	14 sp.,	„

Indian Ocean,	February	'04,	1 sp.,	Buitendijk.
„	January	'06,	15 sp.,	„
„	April	'06,	12 sp.,	„
„	March	'07,	3 sp.,	„
Poeloe Weh,	March 25,	'07,	1 sp.,	„
Java-Sea,	May	'06,	2 sp.,	„

This species is chiefly characterized by the great predominance of the last whorl, in comparison to which the spire, with only 2 or 3 whorls, is extremely small; this proportion is more pronounced here than in any other species. Outer lip deeply fissured, keel very high, separating for some distance the inner lip from the penultimate whorl. By Souleyet and Vayssière transverse ribs, slightly undulating, are particularly noticed, especially on the last whorl. I have seen this sculpture only in empty shells of apparently full-grown specimens (3—4 mm.), in other cases nothing but faint lines of growth could be detected. According to Souleyet, the fissure in the outer lip, and so also the height of the keel near it, are liable to variations; specimens, in which this fissure is very deep, were regarded by the latter author as a variety. Among the few type-specimens of Souleyet I have seen, none of them, however, exhibited a high keel and a shallow fissure, near the outer lip. One of these specimens is figured here (figs. 11 and 12).

Comparing this drawing with those, formerly given by me of *A. oligogyra* (Pl. VIII, figs. 14 and 15, 17 and 18), it is evident that they refer exactly to the same species. Little desirous as I am to increase the number of species, I am fairly satisfied to state this fact, adding, that I have alluded in my monograph (p. 55) to the close affinity of the two species. At that time, however, I had no opportunity of studying an authentic *A. lesueuri.*

I suppose *A. primitia* and *A. cunicula,* both described by Gould, may be the same as *A. lesueuri,* as I moreover suggested already in my monograph (p. 11) for the first species. Here too the spire is extremely small, and is said to be violaceous in *A. primitia.* This colour is also stated

by Souleyet, and I myself found a faint violet-blue colour in some of Mr. Buitendijk's specimens.

A remarkable character of this species is also worth to be mentioned. The animal in spirit-preservation, is always, without exception, of a greyish-white colour, whereas all the other species of the *A. peroni*-group, in the same concondition, exhibit a faint yellow tint. This difference in colour enables to distinguish *A. lesueuri* at first sight.

Group of *Atlanta inflata*.

To this group I have referred three species:

6. *A. inflata* Souleyet.
7. „ *depressa* „
8. „ *helicinoides* „

These species have a short conical spire with obtuse apex, projecting beyond the last whorl, and generally coloured; this tint, however, is not peculiar to the shell itself, but to the gonad of the animal, which occupies the hindmost part of the visceral mass, so being enclosed within the apical whorls. The keel does not penetrate between inner lip and penultimate whorl.

Species 6. *Atlanta inflata* Souleyet.

1852. *Atlanta inflata* Souleyet.
1852. *Atlanta quoyana?* Souleyet, *non* Vayssière.
1904. *Atlanta inclinata* Vayssière (his fig. 90), *non* Souleyet.

(Plates 3 and 4, figs. 13—17).

Dry shells:

Atlantic Ocean, purchased 1907, 1 sp., Sowerby and Fulton.
Indian Ocean, „ „ 6 sp., „

Animals:

Mediterranean,	date?,	6 sp.,	Buitendijk.
Indian Ocean,	February '04,	1 sp.,	„
„	January '06,	5 sp.,	„
„	April '06,	2 sp.,	„

Indian Ocean,	August '06,	1 sp.,	Buitendijk.
„	November '06,	1 sp.,	„
Gulf of Aden,	December '05,	1 sp.,	„
Gulf of Bengal,	August '06,	1 sp.,	„

I have nothing to add to my former description (monograph, pp. 56 and 57, Pl. VIII, figs. 19—21). Spire consisting of 5—7 whorls, the first 3—5 slowly and regularly increasing, penultimate and especially last whorl rapidly enlarging. In order to show the peculiar sculpture of this species and some other characters, I have figured two shells (figs. 13—16). In fig. 13 some (5—6) distinct spiral lines are visible on the first half of the penultimate whorl; I believe this sculpture to be dependent on age, however, as it is gradually disappearing in larger shells of somewhat more than 2 mm. Fissure in outer lip very wide, but shallow. Two whorls visible at under side of the shell. Colour absent on the last whorl, spire faintly brownish, and this colour is particularly pronounced on the suture. The same tint occurs sometimes at the inner lip. Aperture very large.

A. quoyana of Souleyet was not represented in the material from the Paris Museum. I venture to suggest that it may be the same as *A. inflata*. In the material procured by Mr. Buitendijk I found some specimens (figs. 15 and 16), which agree rather well with Souleyet's figures of *A. quoyana* (copied in my monograph, Pl. I, figs. 38 and 39), though these are much too small. Seen from above, the shells of the typical *A. inflata* with its characteristic spire (fig. 13) and that of »*A. quoyana*" (fig. 15) of Mr. Buitendijk agree entirely (except as regards the sculpture, which is absent in the latter), and so do the side-views (figs. 14 and 16); the operculum is also wholly the same (»*A. quoyana*", fig. 17) and shows a double spiral line, but no trace of parallel lines [1]).

1) It may be possible that this negative character is dependent on age, and that the lines make their appearance in quite full-grown shells.

The shell, described by Vayssière under the name of *A. quoyana* (copied in my monograph, Pl. I, fig. 40) is certainly not this species, but must be referred to *A. helicinoides* as I shall attempt to show further on (p. 23).

On the other hand the latter author has designated (p. 55, Pl. VI, fig. 90) under the name of »*A. inclinata*" a specimen, which in my opinion is an *A. inflata*. The shell, seen from apex, agrees exactly with my figure of the type, with the only exceptions, that no spiral sculpture is mentioned, and that the keel penetrates between the penultimate whorl and the inner lip. These two features may be, however, safely supposed to be dependent on age (the specimen of Vayssière measured 2,6 mm.); I have noted previously that the sculpture becomes less distinct in larger shells.

Another specimen of Vayssière, called also »*A. inclinata*", really belongs to *A. fusca* (see p. 26).

Species 7. *Atlanta depressa* Souleyet.

1852. *Atlanta depressa* Souleyet.
1906. *Atlanta rosea* Tesch, *non* Souleyet.

(Plates 3 and 4, figs. 18—22).

Animals:

Indian Ocean,	January	'06,	2 sp.,	Buitendijk.
„	April	'06,	1 sp.,	„
Gulf of Aden,	December	'05,	1 sp.,	„

The types I have studied, had unfortunately their shells quite dissolved. Among the spoils of Mr. Buitendijk, however, I had the good fortune to find some specimens, surely to be referred to *A. depressa*, the typical spire of which (comparatively larger than in *A. inflata*, compare figs. 13 and 18) could be detected even in the damaged type-specimens of Souleyet. This species may be very easily confounded with *A. inflata*, to which it is most nearly related, but it is distinguished: 1°. by the comparatively larger spire,

2°. by the deeper fissure in the outer lip, 3°. by the umbilicus, the three last whorls (in *A. inflata* only two) being visible at the under side of the shell (fig. 20), and 4°. by the absence of colour on the spire. Besides, the spiral sculpture is so slightly pronounced, that even in young shells and with great magnificent power, scarcely any trace of it is to be found. The side views of *A. inflata* (fig. 14) and of *A. depressa* (fig. 19) differ also in the fact, that in the first species the aperture is much larger, and that the spire is a regular, short cone, whereas in *A. depressa* it is somewhat irregular, the first two whorls forming a higher, more elevated cup.

I have figured also a specimen (figs. 21 and 22), which I regard, though hesitatingly, as *A. depressa*. The shell, seen from apex, with its few whorls, resembles *A. lesueuri* [1]), especially on account of numerous curved lines of growth, occurring on the last whorl (fig. 21); the side view on the other hand (fig. 22) is most like that of *A. depressa*. Near the aperture the shell was seriously damaged.

I greatly regret to confess that I have been mistaken in my monograph, in designating the true *A. depressa* of the Siboga-Expedition to *A. rosea* (p. 57, Pl. VIII, figs. 22 and 23). In the collection of the British Museum I had at that time the opportunity to examine, *A. depressa* was not represented, and this may account (and in some way apologize) for my mistake. Comparing the here given figures with those formerly published, the identicalness will be evident.

Species 8. *Atlanta helicinoides* Souleyet.

1852. *Atlanta helicinoides* Souleyet.
1904. *Atlanta quoyana* Vayssière, *non* Souleyet.

(Plates 3 and 4, figs. 23 and 24).

Animals:

Red Sea, January '06, 1 sp., Buitendijk.

1) Here, however, the spire is much smaller in proportion to the last whorl

Indian Ocean,	February	'04,	1 sp.,	Buitendijk.
„	January	'06,	2 sp.,	„
„	April	'06,	4 sp.,	„
„	November	'06,	1 sp.,	„
„	March	'07,	1 sp.,	„
Gulf of Aden,	December	'05,	1 sp.,	„
„	March 17,	'07,	1 sp.,	„
Java-Sea,	May	'06,	1 sp.,	„

This species is very closely allied to *A. inflata*; the whorls, however, are not only fewer in number (5), but the whole spire is much larger (fig. 23), the coils regularly increasing in size, and provided, nearly throughout, with a very distinct spiral sculpture, consisting of 3—4 lines on each whorl; this sculpture exists also at the under side of the shell, on the penultimate whorl, where it is wholly absent in *A. inflata* and *A. depressa*. It may be here once more a feature, disappearing in advancing age, but even then the proportion of spire and last whorl affords a specific distinctness. On side view (fig. 24) the spire has a conical form, somewhat larger and higher than in *A. inflata*. Aperture rather small. Shell colourless, base of the keel diffusely reddish-brown, spire somewhat darker, greyish, owing to the gonad of the animal, in which often, in very regular distances around the suture, dark pigmented spots are to be seen.

I have scarcely any doubt, the shell, figured by Vayssière under the name of »*A. quoyana*", will belong to the species under discussion (copied in my monograph, Pl. I, fig. 40); though nothing is mentioned about the spiral sculpture, the surface view of the shell is exactly the same. The keel extends to the outer lip, but Vayssière himself states, the aperture of his specimen was damaged.

Group of *Atlanta turriculata*.

This group comprises two species:

9. *Atlanta turriculatá* d'Orbigny.
10. *Atlanta fusca* Souleyet.

Shell always coloured, yellowish or brownish, especially on the spire; whorls much rounded in transverse section; keel extending to outer lip.

Species 9. *Atlanta turriculata* d'Orbigny.

1836. *Atlanta turriculata* d'Orbigny.
1852. *Atlanta involuta?* Souleyet.

(Plates 3 and 4, figs. 25 and 26).

Animals:

Indian Ocean,	January	'06,	4 sp.,	Buitendijk.
„	April	'06,	5 sp.,	„
„	September	'06,	1 sp.,	„
„	November	'06,	1 sp.,	„
Gulf of Bengal,	August	'06,	1 sp.,	„

Spire small, forming an elevated, slender cone (fig. 26), last whorl very large (fig. 25), much swollen; aperture rounded, with a small slit in the outer lip. Shell (5—6 whorls) always of a dark yellowish or brownish hue, especially on the spire. No sculpture (except striae of growth) in adult specimens (1,5—2 mm.), but in young ones the shell is adorned throughout by a few very distinct spiral lines; moreover, in these young specimens the spire (though consisting of the same characteristic coils, rapidly descending like those of *Turritella*) projects considerably beyond the last whorl, which is much smaller than in full-grown shells; the whole shell is transparent, only faintly tinted with rose.

As I have pointed out in my monograph (p. 58), the spire is very slightly reflexed backwards; in young shells of about 0,5 mm. (as above described) it is straight.

A. involuta Souleyet was not represented in the collection of the Paris Museum. The side view of this species (copied in my monograph, Pl. I, fig. 18) is very much like that of *A. turriculata* (only there seem to be more whorls in the spire, though Souleyet did not mention more than 6.

Species 10. *Atlanta fusca* Souleyet.

1850. *Atlanta brunnea* [1]) Gray.
1852. *Atlanta fusca* Souleyet.
1904. *Atlanta inclinata* Vayssière (his fig. 91), *non* Souleyet.

(Plates 3 and 4, figs. 27—29).

Dry shells:

Indian Ocean, purchased 1907, 5 sp., Sowerby and Fulton.

Animals:

Red Sea,	April	'06,	1 sp.,	Buitendijk.
Indian Ocean,	September	'06,	1 sp.,	„
„	July	'07,	1 sp.,	„

At first sight this species may be confounded with *A. inflata* or *A. helicinoides*. It is, however, distinguished by a whole series of characters: 1°. by the spire forming a short cone with a more pointed apex (fig. 28), 2°. by the very broad keel, extending to inner and outer lip, and so encircling the whole shell, 3°. by the dark horn-colour, also on the keel, about the same as in the foregoing species, especially on the spire, and 4°. by a very characteristic sculpture: 2—3 spiral lines on the apical whorls, which number increases to 12—14 on the second half of the penultimate whorl (fig. 27), where these lines are slightly undulated (fig. 28). Around the umbilicus 5—7 spiral lines, likewise undulating, are distinctly visible. In no other species of *Atlanta* the spiral sculpture is so strongly accentuated, it occurs even in the largest shells of 2—2,5 mm., and may persist throughout the whole life of the animal. Transverse striae of growth are also very distinct on the last whorl, and here another remarkable feature may be mentioned: numerous rows of tiny points, parallel

1) This name has been given by Gray, translating „Atlante brune", under which title the species is designated by Souleyet in the Atlas of the „Voyage de la Bonite", which appeared already in 1842.

to each other, and crossing the lines of growth, not to be confounded with the undulating spiral sculpture at the beginning of the last whorl. In fig. 27 they are not figured.

A specimen, figured [1]) by Vayssière under the name of »*A. inclinata*" (fig. 91), most likely belongs to *A. fusca*, chiefly on account of the »nombreuses lignes longitudinales parallèles, constituées par une multitude de petites ponctuations." No mention is made, however, of the much coarser sculpture on the spire, which would certainly have been observed, if present.

Group of *Atlanta inclinata*.

It contains two species:

11. *Atlanta inclinata* Souleyet.
12. *Atlanta gibbosa* Souleyet.

These species are certainly not nearly related, and I have enclosed them in one group only for the sake of convenience, as, though mutually very clearly distinct, they are separated off from the other species by their large, conical spire, which is always reflexed on the last whorl, either forward or backward.

Species 11. *Atlanta inclinata* Souleyet.

1852. *Atlanta inclinata* Souleyet, *non* Vayssière.

(Plate 5, figs. 30—32).

Animals:

Red Sea,	January	'06,	1 sp.,	Buitendijk.
„	April	'06,	1 sp.,	„
Indian Ocean,	April	'06,	1 sp.,	„

This beautiful species is easily recognisable by the following characters: 1°. the large spire forms a short

1) Another specimen (fig. 90) under the same title is probably *A. inflata* (see p. 21).

cone, which is very conspicuously reflexed on the last whorl (figs. 30 and 31), 2°. the keel extends for some distance on the penultimate whorl, and 3°. the whole shell is colourless and quite transparent, with exception of an occasional diffuse brownish hue at the inner lip. Aperture rounded (fig. 31), outer lip deeply fissured.

In one of the type-specimens of Souleyet, which I have figured here, a remarkable sculpture is visible on the spire (fig. 30), consisting of numerous transverse striae, radiating from the apex, mostly on the 2nd, 3rd and 4th whorl. In other specimens I have not observed this feature. The same shell also exhibits (fig. 32) around the umbilicus, and likewise radiating from it, a number of very fine grooves, slightly undulating in their course; here the penultimate whorl (as in all the specimens I have seen) is not rounded, but forms an obtuse angle in transverse section (fig. 32). On the last whorl transverse lines of growth are very distinct.

Species 12. *Atlanta gibbosa* Souleyet.

1852. *Atlanta gibbosa* Souleyet.
1859. *Atlanta gibba* Chenu.

(Plate 5, figs. 33 and 34).

Dry shells:

Indian Ocean, purchased 1907, 2 sp., Sowerby and Fulton.

Animals:

Red Sea,	April	'06,	1 sp.,	Buitendijk.
Indian Ocean,	January	'06,	1 sp.,	„
„	April	'06,	1 sp.,	„
Gulf of Aden,	August	'06,	1 sp.,	„

Spire very large, more than in any other species (fig. 33), reflexed forward; last whorl comparatively small (fig. 34); outer lip deeply fissured. A single spiral line, following the suture (fig. 34). Shell colourless, entirely transparent.

This small species resembles very much a young stage of

some *Atlanta*, as the large, elevated, conical spire, which gives to the shell a rather regular (and so in *Atlanta* very uncommon) appearance, is much like that of larval forms. Formerly (monograph, p. 60) I have pointed out why I regard *A. gibbosa* certainly as a distinct species.

The following is a list of the species of the Atlantidae in the Leyden Museum:

Oxygyrus keraudreni (Lesueur).
" *rangi* (Souleyet).
Atlanta peroni Lesueur.
" *gaudichaudi* Souleyet.
" *lesueuri* "
" *inflata* "
" *depressa* "
" *helicinoides* "
" *turriculata* d'Orbigny.
" *fusca* Souleyet.
" *inclinata* "
" *gibbosa* "

So the Museum possesses 12 of the 15 species I have accepted in this paper. Absent are *Protatlanta souleyeti* (Smith), *Atlanta steindachneri* Oberwimmer and *Atlanta affinis* Tesch.

Horizontal Distribution.

With the information now available it seems possible to add a few notes about the horizontal distribution of the Atlantidae. It seemed advisable to me to reject such notes, distributed in literature, which are not sufficiently verified, and for that reason I feel justified in mentioning only the following authors:

Souleyet (»Bonite").
Smith (»Challenger").
Oberwimmer (»Pola").
Vayssière (»Hirondelle" and »Princesse Alice").
Tesch (»Siboga" and collection Leyden Museum).

Name of the species	Atlantic	Mediterrancan	Red Sea with Gulf of Aden	Indian Ocean	Malay Archipelago	Pacific
Oxygyrus keraudreni (Les.)	×	×	—	×	—	—
„ *rangi* (Soul.)	—	×	—	×	×	×
Protatlanta souleyeti (Sm.)	×	—	—	—	—	—
Atlanta peroni (Les.)	×	×	×	×	×	×
„ *steindachneri* Ob.	—	×	—	—	—	—
„ *affinis* Tesch	—	—	—	—	×	—
„ *gaudichaudi* Soul.	—	—	×	×	×	×
„ *lesueuri* Soul.	×	×	×	×	×	×
„ *inflata* Soul.	×	×	×	×	×	×
„ *depressa* Soul.	—	—	×	×	×	×
„ *helicinoides* Soul.	×	—	×	×	×	×
„ *turriculata* d'Orb.	—	—	—	×	×	×
„ *fusca* Soul.	×	—[1]	×	×	×	×
„ *inclinata* Soul.	×	—	×	×	×	×
„ *gibbosa* Soul.	×	—	×	×	×	—

In the future most species, if not all, will prove to be cosmopolitical, I think. The Atlantidae, as all other Heteropoda, are inhabitants of tropical and subtropical regions, and never any species has been recorded from boreal or notal waters, and indeed will die very soon, if occasionally carried away by currents into high latitudes.

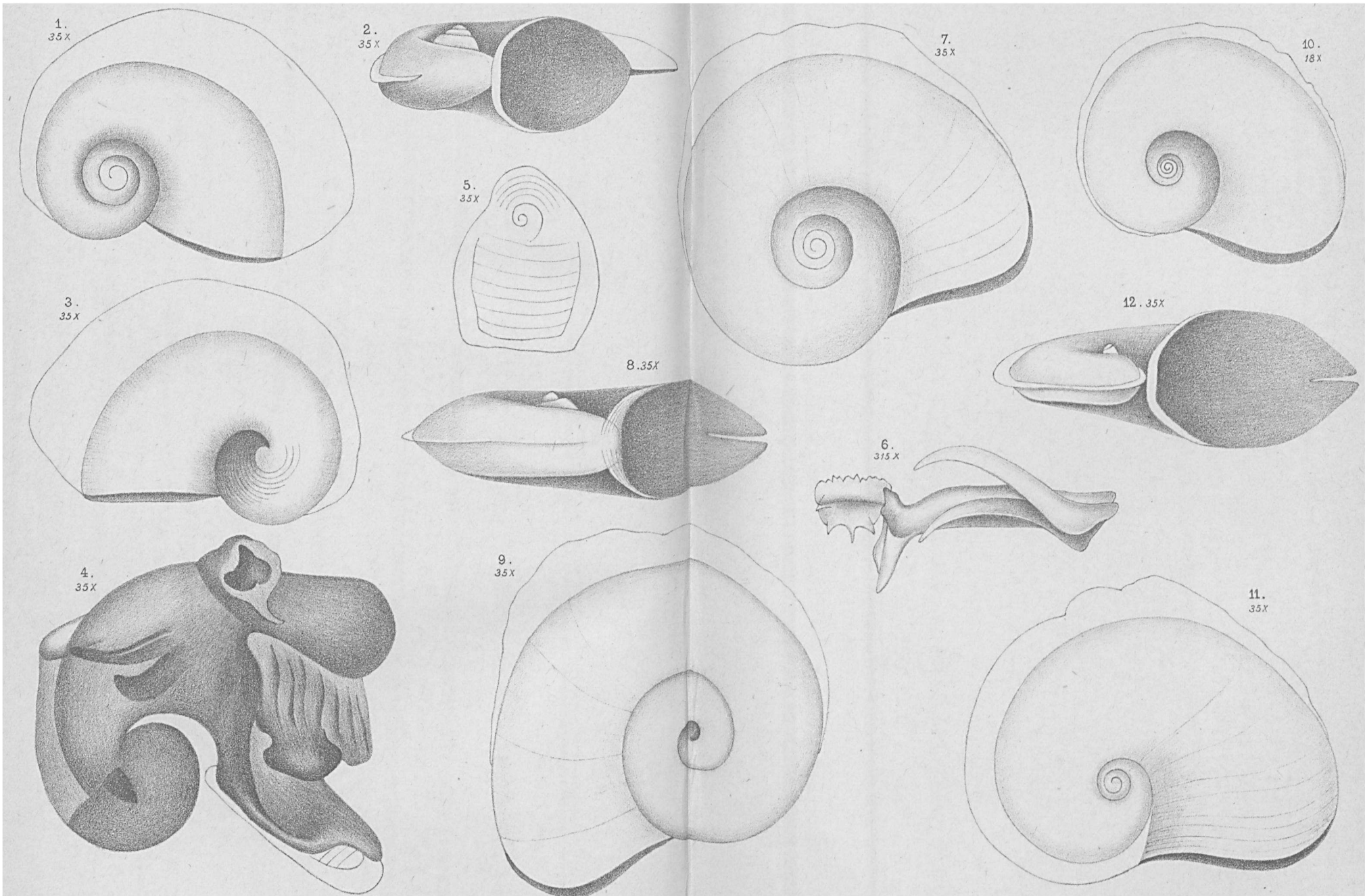
EXPLANATION OF FIGURES.

Fig. 1		Shell from apex.
„ 2		„ from aperture.
„ 3		„ from umbilicus.
„ 4	*Protatlanta souleyeti* (Smith)	Animal, removed from shell, from the right.
„ 5		Operculum, view from inside.
„ 6		Transverse row of radula.
„ 7	*Atlanta peroni* Lesueur (*rosea*-form)	Shell from apex.
„ 8		„ from aperture.
„ 9		„ from umbilicus.
„ 10	*Atlanta gaudichaudi* Souleyet.	„ from apex.
„ 11	*Atlanta lesueuri* Souleyet	„ from apex.
„ 12		„ from aperture.

1) Recorded by Oberwimmer, but without figure.

Fig. 13	*Atlanta inflata* Souleyet	Shell from apex.
„ 14		„ from aperture.
„ 15		„ from apex (*quoyana?* see text).
„ 16		„ from aperture (*quoyana?* see text).
„ 17		Operculum, inside view (*quoyana?* see text).
„ 18	*Atlanta depressa* Souleyet	Shell from apex.
„ 19		„ from aperture.
„ 20		„ from umbilicus.
„ 21		„ from apex (see text).
„ 22		„ from aperture (see text).
„ 23	*Atlanta helicinoides* Souleyet	„ from apex.
„ 24		„ from aperture.
„ 25	*Atlanta turriculata* d'Orbigny	„ from apex.
„ 26		„ from aperture.
„ 27	*Atlanta fusca* Souleyet	„ from apex.
„ 28		„ from aperture.
„ 29		„ from umbilicus.
„ 30	*Atlanta inclinata* Souleyet	„ from apex.
„ 31		„ from aperture.
„ 32		„ from umbilicus.
„ 33	*Atlanta gibbosa* Souleyet	„ from apex.
„ 34		„ from aperture.

Leyden Museum, January 1908.



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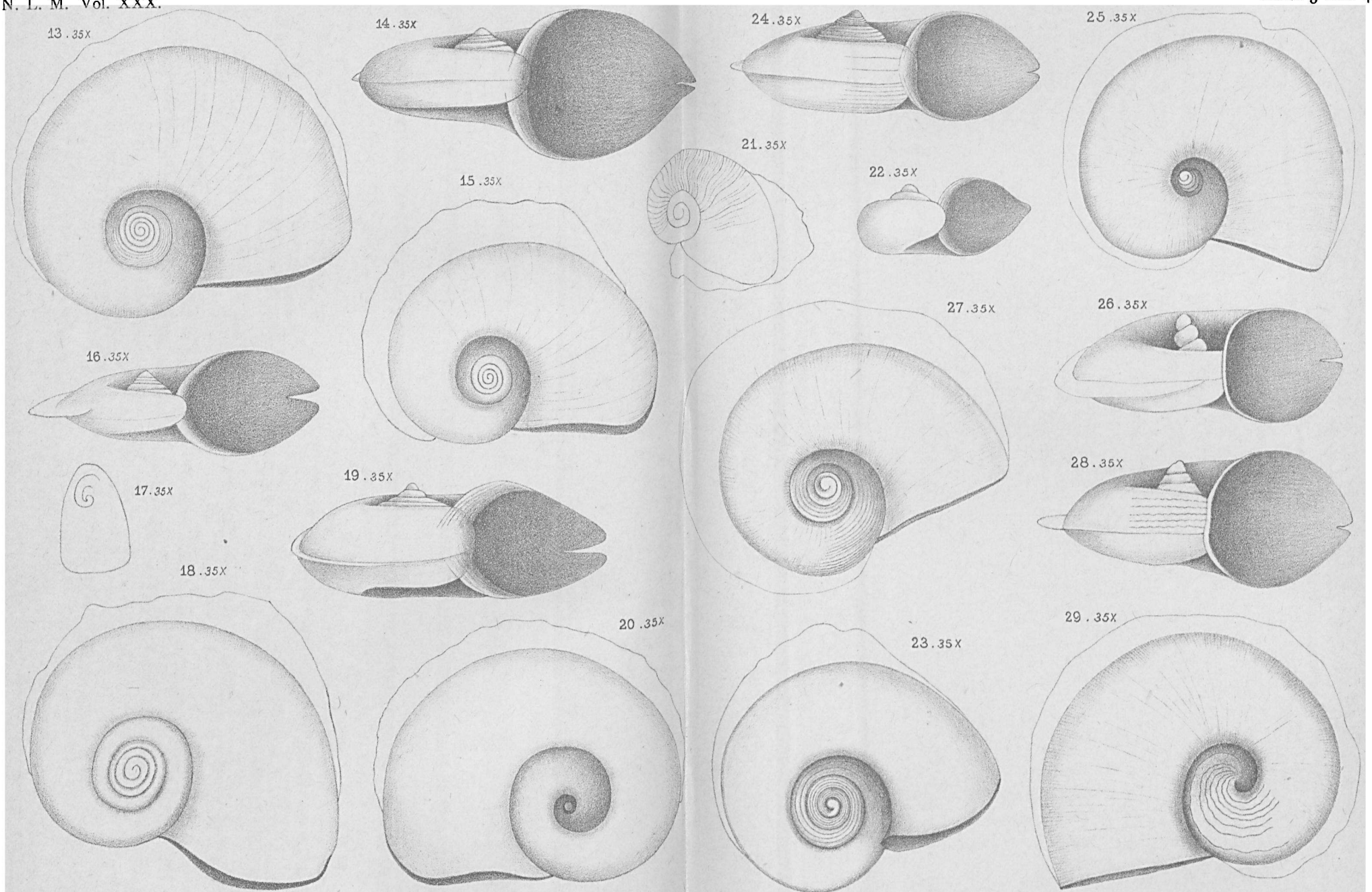
Figs. 1—6. Protatlanta souleyeti *Smith.*
„ 7—9. Atlanta rosea *Souleyet* (= A. peroni *Lesueur*).
Fig. 10. Atlanta gaudichaudi *Souleyet.*
Figs. 11—12. „ lesueuri *Souleyet.*



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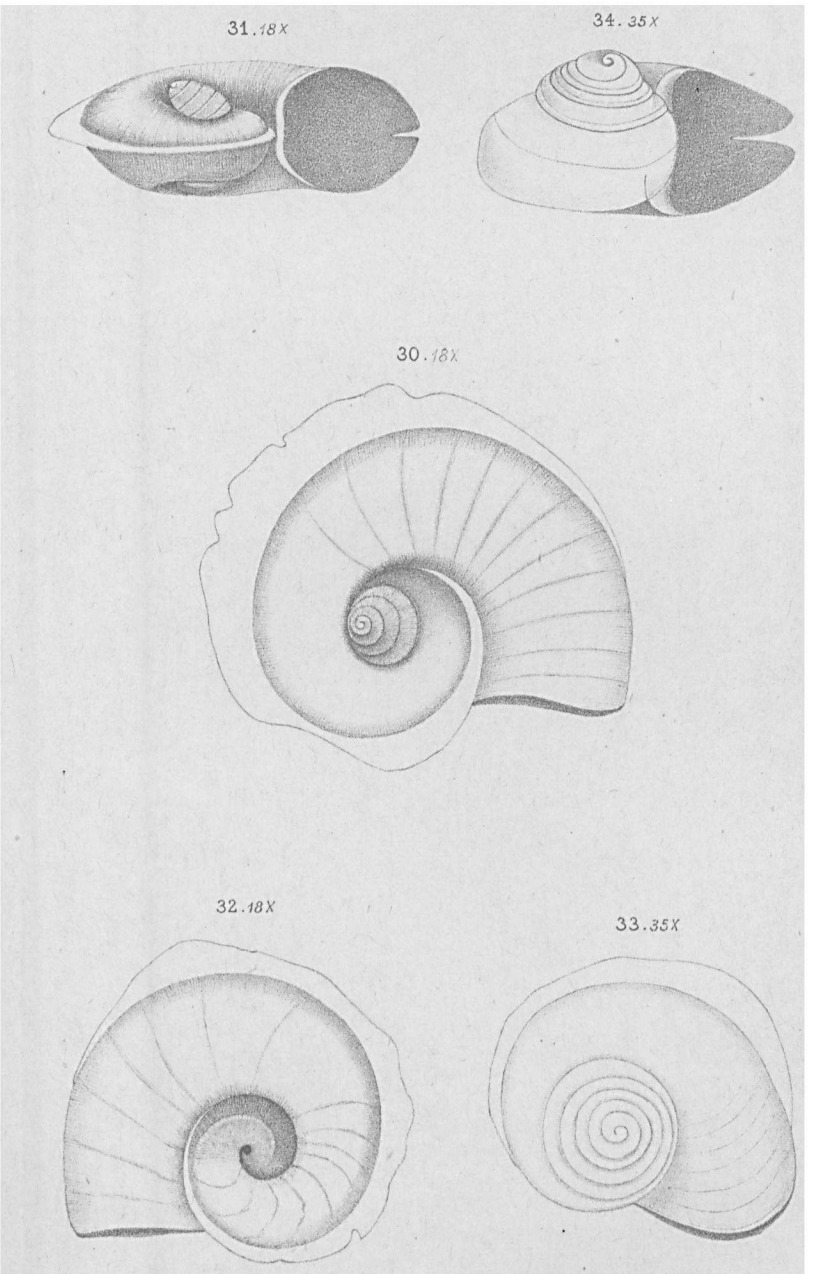
Figs. 13—14. Atlanta inflata *Souleyet*.
„ 15—17. „ quoyana? *Souleyet*.
„ 18—20. „ depressa *Souleyet*.
Figs. 21—22. Atlanta depressa (?) *Souleyet*.
„ 23—24. „ helicinoides *Souleyet*.
„ 25—26. „ turriculata *d'Orbigny*.
Figs. 27—29. Atlanta fusca *Souleyet*.



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Figs. 30—32. Atlanta inclinata *Souleyet.*
„ 33—34. „ gibbosa *Souleyet.*